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The American Biology Teacher

NOVEMBER, 1957 VOLUME 19, NO. 7

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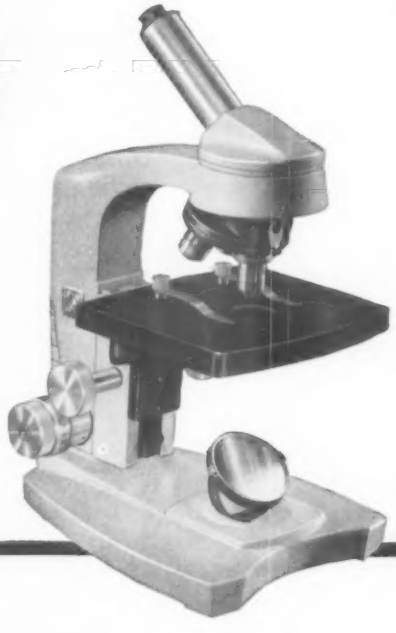

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Cover Photograph

Geaster sp., commonly called Earth Star, is closely related to the puffballs. It opens in dry weather, raising plant from ground, and closes in wet weather, bringing spore-bearing sphere again close to the ground. Photograph by Samual Postlethwait, Associate Professor of Botany, Purdue University.

THE AMERICAN BIOLOGY TEACHER

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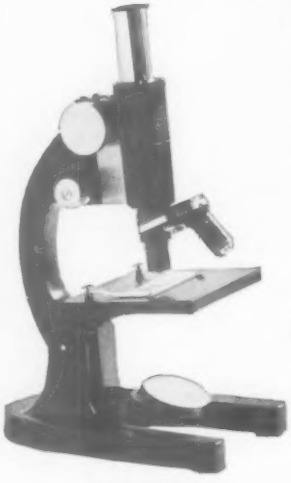

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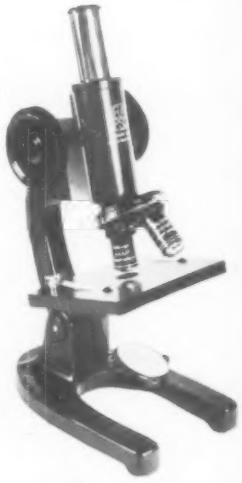

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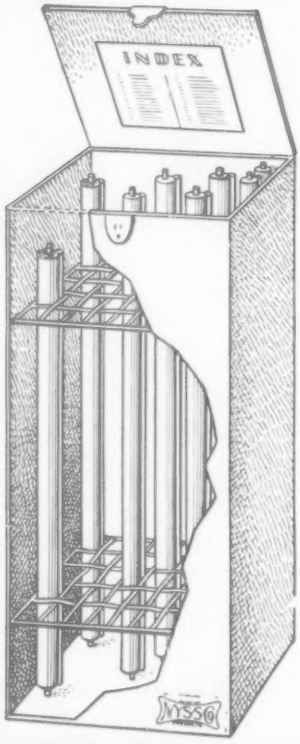

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Teaching Aids Can Be Personal and Inexpensive

SAMUEL N. POSTLETHWAIT and FOREST STEARNS
Department of Biological Sciences, Purdue University

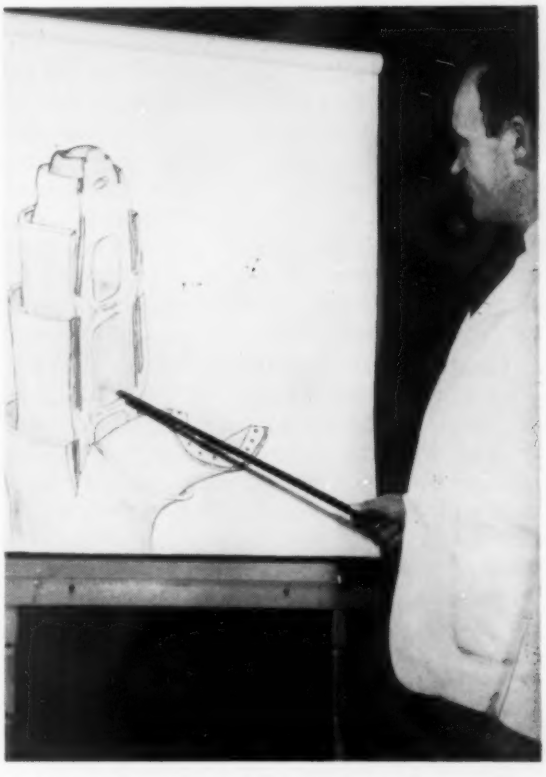
It is nothing new to hear that biology can be taught better using visual aids—models, charts, slides and live material. With such devices the teacher can approach his subject using all of the senses his students possess. Although teaching aids and models should not supplant live material, still in many instances they can show form and structure, especially of microscopic nature, far better than the living organism itself.

Despite the growing profusion of teaching aids on the market today there are many instances when the proper model or chart to emphasize a particular point is not available, or the school budget is so limited that commercial models are out of the question. Under these circumstances some instructors may find helpful one or more of the methods suggested below. In addition the fun and stimulation of devising models or making drawings to illustrate one's own approach to the subject will encourage many to make their own teaching aids. The construction of charts and models provides excellent special projects for students and requires little guidance after the initial impetus is given.

USE OF THE EASEL

Drawings were probably the first visual teaching aids to portray an actual object. Drawings and charts as we all know vary greatly in form and complexity, in accuracy and in attractiveness. This preparation can be a rather tedious job involving careful measurement in which the results frequently do not match either labor or anticipation, or it can be made easy by the use of an easel and opaque projector.

Artists have long used a portable frame or easel to support their canvas while portraying the landscape. In more recent times extension workers and others have modified the easel technique by placing a pad of paper on the easel and drawing as they talk to a group. A variation of this method is to make the drawing first and then, with a pad of large, simple, drawings or sketches mounted on the easel, the instructor merely flips the pages as he develops his story. Obviously this is not a new device but none-the-less a useful one which, in our observation, could be more widely adapted to use in teaching biology in high schools and colleges.



Professor Forest Stearns demonstrating the use of an easel with a homemade chart of a wheat stem.

Polished drawings or simple, but pointed, sketches can be made prior to the presentation of the material and then can be stored for future use. This permits a relaxed approach to the class; the instructor does not have to fill the board with hurried drawings (good or bad) while trying to hold the attention of his students. The paper available for use on the commercial (or homemade type) easel is inexpensive so that a chart once made doesn't have to be considered inviolable but can be

destroyed without injuring anything except artistic sensitivity of the maker.

In our opinion one of the prime advantages of the use of the easel in making charts is that one can focus attention on important ideas by eliminating excess detail. A second major advantage is the fact that charts or drawings can be reproduced from the same sources (i.e., text or lab manual) that are being used by the students. These drawings can be labeled and colored in such a way that there will be no necessity for long and repetitious discussions starting "But I thought that you said that a round, thick-walled, empty cell was a guard cell." Such charts are useful for students to check their labeling after completing laboratory work as well as for discussion purposes.

The making of visual material on an easel is a simple process. The pad of paper is placed on the easel, a backing sheet is placed between the top sheet and the next one to prevent ink leakage and the drawing is made. Sometimes it is preferable to sketch out the drawing in pencil, but the bolder of us will start right in with a felt pen and place the drawing directly on the pad. Felt pens are available with different points and can be used with many different colors. It is wise, if many drawings are to be made, to have several pens, one for each color desired. After the outline is complete it can be colored with chalk. When chalk is used a coat of clear plastic is applied as a spray (from a pressure dispenser) to prevent smearing.

In a series of charts showing development of a particular structure, color can be used in a functional way to focus students' attention on continuity and change in different tissues. For instance in a series showing the development of a bean seed from an ovule one can use a specific color for the embryo, for the endosperm and for the integuments. Changes in relative amounts of color indicate, at a glance, the gradual growth of the embryo at the expense of the endosperm. If the chart is to be permanent the edges of the paper are taped to prevent tearing and it is ready for use. To expedite the making of charts from material in your text or manual the only other piece of equipment necessary is an opaque projector. The chart is projected directly on the easel in a darkened room and the lines are traced directly on the pad with a felt pen. In this way duplicate charts can be produced rapidly and new ones can be made when texts or manuals are changed.

MODELS FROM SHEET PLASTIC

Various substances from rubber to papermache have been used as media from which to construct models. Building on a technique used by Dr. H. L. Hulbary (State University of Iowa) we have found that an excellent material for model construction is sheet plastic ("pyralin"). This material is readily adapted to a variety of models such as those shown in figs. 1-6. Cell types and other structural features are effectively portrayed by this material.

To assemble models one needs only a little equipment, some manual dexterity, considerable patience and a little ingenuity. A student soon can learn to manipulate the plastic and will often turn out excellent models. For equipment and materials one needs (1) commercial "pyralin" sheets which are available in several thicknesses. We prefer sheets 0.0125 inches thick. The material can be obtained as clear, translucent or colored sheets, 20 x 50 inches in size. (2) Implements for cutting the plastic are those you probably already have available. Scissors, razor blades, paper trimmer and ruler will be ample. (3) Ordinary cellophane ("Scotch") tape is necessary to hold the units together during assembly. (4) Acetone applied with a camel's hair brush is used to "cement" or "weld" the pieces of plastic together.

The following steps will serve as a guide for the initial attempts at model construction: (1) Plan the model completely making sketches and figuring dimensions of all parts. Give special attention to corners requiring reinforcement and to arrangement of the assembly so that access can be had to all joints for the application of acetone. Include accessory materials which are to be enclosed in or attached to the model so that they will be incorporated at the proper stage of assembly. Wherever it is possible, plan to bend or fold one piece of the plastic to make two or more sides of the model rather than using several separate pieces. This will produce a stronger and more rigid model. (2) When the planning is completed, all plastic units can be cut to *accurate* size and shape for assembly. (3) Assembly is begun by fastening the edges of the first two units firmly together with cellophane tape as shown in fig. 8. The two

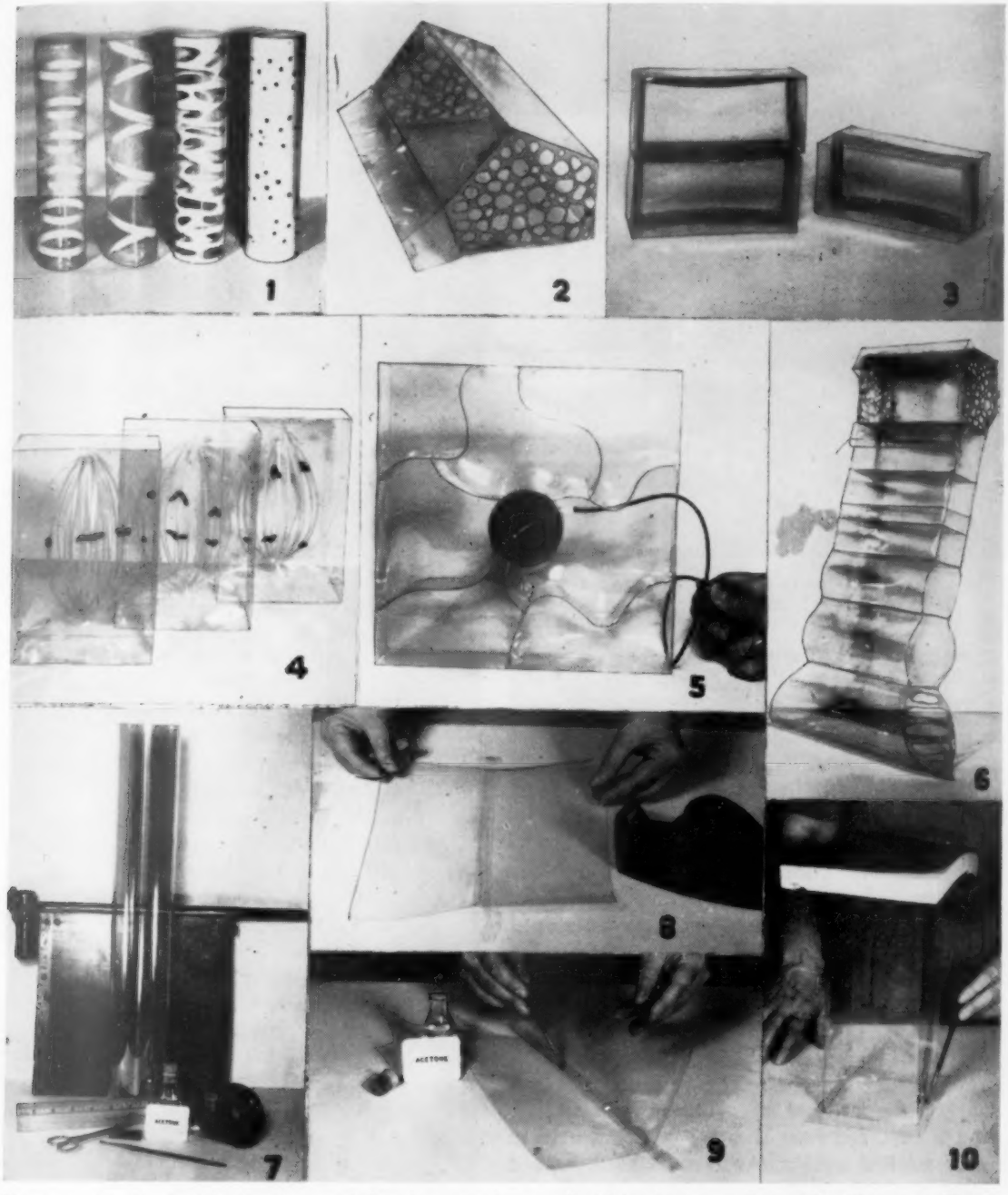
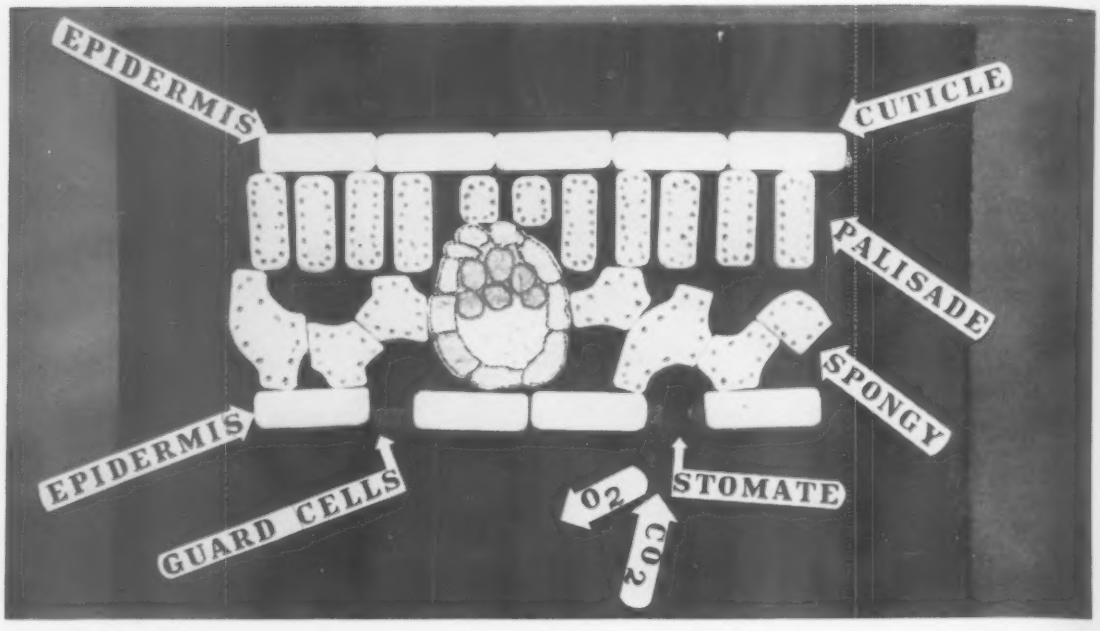


Figure 1. Plastic models showing variation in secondary wall thickening on xylem cells. Figure 2. Plastic model of a sieve tube element and companion cell. Figure 3. Plastic models of endodermal cells with Casparian strips. Figure 4. Models of Mitosis. Figure 5. Model of guard cells. Figure 6. Model of cambial cell and derivatives. Figure 7. Equipment for making models. Figure 8 and 9. Steps in "welding" together two pieces of plastic. Figure 10. "Welding" a cover on a plastic box.

units are adjusted to the appropriate angle and acetone is applied along the inner surface of the angle (fig. 9). The plastic edges partially dissolve in the acetone allowing the two units to fuse at the point of contact. When the acetone evaporates the plastic edges remain fused. The strength of the joint depends upon the continuity of the plastic edges and the



This model of tissues in the cross section of a leaf is designed to be constructed during lecture. The cells are made of styrofoam and held to the steel sheet by a magnet.

amount of solvent applied. Too much acetone softens the plastic and results in weak points. A few trys with pieces of plastic and acetone will enable the model builder to judge the proper amount. A "curing" period of 5 or 10 minutes (or occasionally longer) is required before the joint is "set" and before the next step in assembly can be accomplished. (4) Further assembly continues stepwise using the same procedure. The cellophane tape should be removed after the joint is well set and acetone is then applied to the external surface to make the "weld" more firm and to smooth the edge of the joint. An alternate method for holding the plastic units in place is shown in fig. 10. This method is especially useful in attaching end pieces. The end unit is cut larger than its final size. The assembled portion is inverted over the end unit and held in place with a weight. Acetone is then applied along each edge and the new joints are allowed to dry or "cure." When "curing" is complete the end unit can be trimmed to the proper size. Variation can be obtained by the use of colored, translucent, opaque and transparent plastic sheets. Patterns of secondary wall thickening in vessels and tracheids are readily represented using a combination of opaque and transparent plastic (fig. 1). End walls of sieve tube elements can be simulated by burning irregular holes in the end plate with a hot needle (fig. 2). CAUTION!! Cellulose nitrate plastic is inflammable, therefore great care must be exercised when attempting this operation. The use of thin strips of cork cemented to the inside of a cell model suggests the Casparian strips of an endodermal cell (fig. 3). Many other variations will suggest themselves to the instructor or student using this material.

Further variation in molding and shaping sheet plastic can be accomplished to a certain extent by boiling the plastic in water or soaking it in a solution of one part acetone and two parts water. The plastic must be molded while hot or immediately after it has softened in the acetone solution since it soon returns to its original state of rigidity.

STYROFOAM MODELS

Styrofoam plastic is another relatively new material for model construction. Florists and decorators are using styrofoam extensively in floral and window displays. The material is low in cost, easily shaped, and comes in a variety of colors, white, green, red and blue. It can be procured in slabs and small spheres. Cutting it into units is most rapidly done with a power band saw, jig saw, or a hot wire. Pieces of different colors can be fastened or

A styrofoam model to demonstrate the ring formation of the sugar molecule with an oxygen and hydrogen atom on each end.

glued together.

With this material one can produce solid models which are exceedingly light. Models of chemical compounds can be held together by connectors made of copper wire. The sugar molecule illustrated is made up in this way, several of these molecules can be used to demonstrate enzymatic synthesis and hydrolysis of starch.

Styrofoam units can be assembled effectively into a 3-dimensional picture. Small steel magnets are fastened to the back of the styrofoam units with masking tape and similarly to labels made from stiff cardboard. A galvanized steel plate painted black serves as the background on which these units are placed when the plant structure, like the leaf in the illustration, is being constructed in discussion. Subjects like nuclear division and genetics are especially suited to the use of this technique.

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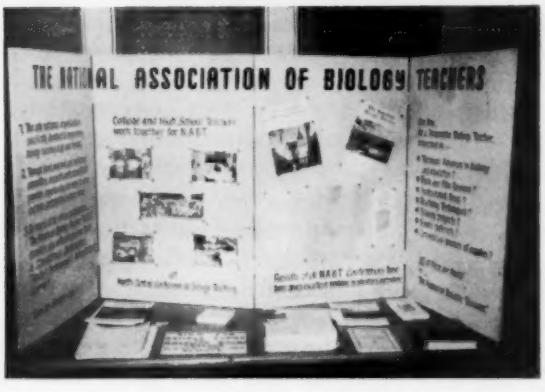

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For Science Students Only*

FERNANDUS PAYNE
Dean Emeritus, Graduate School, Indiana University

My remarks are addressed primarily to young boys and girls who have an interest in science and who may wish to become professional scientists. What I shall say comes near the end of a long life devoted to the study and advancement of science and is said, not with any intention of telling you where to go from here, but with the hope of causing you to stop and think along the way toward your goal.

The word "science" has diverse meanings and may include any and all forms of organized knowledge, but when I speak of science I am thinking of subjects such as physics, chemistry, biology, astronomy, geology and their numerous subdivisions. Even restricted in this way the word "science" covers many broad areas and offers diverse opportunities for developing your individual interests.

The study of science may be approached from two points of view. One is known as the applied, the other, the basic. Are these approaches fundamentally different and if so what is the difference? In the applied and developmental sciences students are interested in the end products and their usefulness to man in his struggle for better and longer living. Industrial organizations such as General Electric, General Motors, Du Pont and Standard Oil, while supplying us with many of our needs, have financial gain as the major stimulus for their great developmental programs. The physician is interested in the applications of drugs or other therapy in the prevention and cure of disease. Investigators in the fields of the basic sciences are not directly concerned with applications. They are men and women with inquisitive minds who want to know more about things around them. They are the scientists who discovered the laws of motion and gravitation, the speed of light, the chemical elements and their properties, penicillin and hundreds of other facts and phenomena. Their interests are not commercial, though they may be in part humanitarian. Even low salaries are not deterrents so long as they have the opportunities of doing what they want to do, of satisfying their curiosity, of expanding the frontiers of knowledge.

Perhaps you don't fully understand this lure which leads men to devote their lives to basic science. Neither do I fully understand it, but it seems some men and women are like that. With discovery comes an inner satisfaction, a joy, an exhilaration such as one may experience in climbing a mountain, looking at the beauty and grandeur of the Grand Canyon, the majestic Matterhorn or a giant Sequoia. At the two extremes the two aspects of scientific research are very different but they actually intergrade. At times the investigator of the applied or developmental is forced to make basic studies before he can proceed with the applied. On the other hand the student of basic research is always pleased when some use is found for his discoveries. Perhaps the main difference lies in the attitudes of the two groups. The investigator of basic research wants complete freedom to go wherever his interests take him. In attempting to solve a scientific problem or discover an unknown the path on which you start seldom leads straight through to a solution. There will be bypaths to follow, and which may take you away, at least temporarily, from the main problem. To study any problem he wishes and to follow any lead which appears, is the freedom the investigator of basic science demands and which he must have if he is to be an effective worker. The universities grant such freedom and that is why most such persons are found in universities.

In contrast, the investigator of applied or developmental science does not usually have the freedom to select his own problems. There are exceptions, of course. The problem is assigned to him by an agency, corporation or director of research. It may be a problem in the development of an alloy to withstand

*An address at an Awards Banquet of the Indiana State Science Talent Search Committee.

extreme heats; how to get more power from gasoline; the synthesis of cortisone or the discovery of a polio vaccine. In each case a specific end is in view and the investigator works toward that end. This type of research is important and will remain important if we are to maintain our present standards of living. Because of competition, as well as a desire to produce better products, business corporations find developmental research necessary. In war times the federal government spends billions of dollars for developmental research, sometimes to the neglect of the basic. Without basic research there can be no applied, for the obvious reason that there would be nothing to apply. I mention these two aspects of research, so you will understand the difference and choose accordingly. At the present time the greatest need is in the basic field.

Assuming you are interested in contributing to the advancement of science, there are several ways in which this can be done. Naturally the most obvious and direct way is through research. Research, however, requires workers or scientists. These scientists must be educated. So teaching, especially in high schools, colleges and graduate schools, is essential for the advancement of science.

While research scientists are highly individualistic and demand a minimum of direction from others, large corporations which employ thousands of scientists sometimes concentrate the efforts of many workers toward the solution of a problem. In times of emergency, such as that through which we are now passing, the federal government finds it necessary to speed up production of war materials and to devise new weapons of offense and defense. Here, too, many scientists may be employed on given projects. Because basic research must not lag, the government now subsidizes many scientists wherever they are found to the extent of many millions of dollars annually. All these efforts must be coordinated and administered. Also within our universities, as research activities are multiplied and accelerated, administration enters. Administration then, is another way in which there are opportunities to help advance science.

Today there is some misunderstanding, some lack of appreciation, some skepticism on the part of the general public, even among some government officials, as to the value of science, so it is important that the public be informed. Perhaps you may have a flair in the direction of science writing or speaking. If so, by all means use it for here is another way to contribute to the advancement of science.

Recognizing that there are different ways in which you may contribute to the advancement of science, how should you be educated? Your future success depends to a large extent upon the equipment with which you start. In educating yourselves for scientific careers, however, keep in mind that you will be citizens of your community and of the nation and as such have certain obligations and responsibilities to fulfill. Also keep in mind that in any life you lead, there should be hours of recreation, relaxation, hours to enjoy the beautiful and the good in nature, in the arts, literature, history. Your education, then, should not be too narrowly conceived. The tendency today is toward more and more specialization. This is understandable as the accumulated knowledge in any one science such as chemistry or biology has become so great that no one can know the whole of it even in a lifetime. So we become geneticists, endocrinologists, protein chemists, nuclear physicists or specialists in one of the other hundreds of subdivisions of science. There is another reason for prescribing more and more requirements. While we still speak of chemistry, physics, zoology, botany, physiology, bacteriology, etc., as separate disciplines, the fields overlap and are moving more toward unity. The well-educated biologist today needs to know not only plants and animals, but if he is to study living substance and how it functions, he must also know something of physics and chemistry. Mathematics is a necessity in certain areas and useful in others. The chemist must know physics and mathematics as minimum requirements. As a result, graduate schools place requirements upon college graduates for admission to graduate school. They may even specify hours and courses, forcing specialization in the college where general education is preferable. The colleges reach down into the high schools specifying requirements for admission to college. Some of these requirements are good, but when they force premature specialization they become questionable. In spite of the pressure for early specialization in order to educate yourselves adequately in the sciences, I warn you of the

dangers. We might say science consists of facts and their significance, their meaning. To make interpretations, to build hypotheses, we need to know relationships, to see things in broad perspective. Narrow specialization restricts vision.

Ahead of you are four years in college and three or more years in graduate school—a long road you may think. Not only is it essential that you plan these programs wisely, but also that you choose the college and graduate school best suited to your needs. It is true that students learn through their own efforts, but faculties, libraries and scientific equipment are important aids. The graduate school is the time and place for specialization. At that stage you should know your major interest and you should choose the scientist with whom you want to work whether that person be at university X, Y or Z. Too many graduate students select a university because of its general reputation, assuming the department in which they wish to work is strong, or they go to the one offering the largest financial return regardless of its fitness to offer graduate work in the area in which they wish to specialize. Even the best of our universities are not equally strong in all departments.

You may feel handicapped for lack of knowledge about colleges, universities and scientists, and I admit accurate information is not easily obtained. Your teachers should be able to help you but sometimes their knowledge is limited. Teachers, too, have one weakness, common to many others. They are inclined to advise you to go to the college or graduate school which they attended. Hence, seek information from many sources and counsel from many people. In the end use your own best judgment, but be sure you have formed a judgment of your own. You may feel incapable of making such important decisions, but learning to form judgments is a part of your education.

After you complete college and graduate school programs and qualify as beginning scientists there are, as I have said, several paths you may follow. You may devote your life to teaching in high school or to teaching and research in colleges or universities. In high schools little or no research is done. There is neither time nor equipment. The opportunity for interesting young people in science, however, is unlimited and the need for more and better educated teachers of science is increasing as the population zooms upward. In most colleges and in many universities the major emphasis is on teaching. There is so little time for research, and equipment and libraries are inadequate. Even in these institutions, however, those with the will to do so may find some time for research. In teaching you have an opportunity to contribute to the advancement of science through interesting and stimulating students to enter upon a study of science. Most students who seek entrance to our graduate schools come from small independent colleges. Sometimes I think this contribution of college teachers is greater than that of graduate school teachers. In the best universities emphasis is placed on research and graduate teaching as well as upon the college program. By the best I mean those staffed with the best personnel, with libraries and equipment adequate for both teaching and research and with high scholastic standards.

There is much to be said in favor of a scientist devoting his life to teaching and research. To do research to the exclusion of teaching may become somewhat monotonous. In teaching you have the opportunity of association with young students whom you should find stimulating and who should contribute new ideas from time to time if you encourage them to do so. From these remarks you may infer that I am somewhat prejudiced in favor of this choice. I admit I am. This is the choice I made years ago and if I had my life to live over again I would make the same decision.

Today, more than in previous years, there are opportunities for full time jobs in research in the federal government and in industry. Most, however, are in applied and developmental fields. These positions are attractive from many points of view. Salaries, on the whole, are better than in colleges and universities, and with the present high cost of living this is a major factor. While many scientists are willing to make sacrifices in order to do what they want to do, there are limits. They are no longer recluses, but men of the world and wish to live accordingly. An impression may exist, false to be sure, that teaching is dull. Dullness does not exist in things, however, but in the minds of people. There is also an impression that research is more stimulating and that it is given greater recognition. Per-

haps, too, there is a tendency to respond to the great need for scientists in the applied fields. In addition, great developments such as planes which travel beyond the speed of sound, submarines powered with fissionable materials and guided rockets, appeal to young people with imaginative and venturesome minds.

Perhaps you are too young to think of opportunities in administration. After spending 24 years in administrative capacities of one kind or another, tasks which I never sought, I warn you to beware of lures to entice you in this direction. If administration is thrust upon you, however, I make these suggestions. Remember your main job is to aid scientists in the advancement of science. Be tolerant of the idiosyncrasies of others. If you are human you, too, will have some faults. Don't assume you are all-wise. Recognize worth wherever found. Don't be a publicity seeker. Keep yourself in the background. Select capable scientists, provide them with time and equipment, then get out of the way. I would not belittle, however, the part which the administrator plays. The trouble is there are too few good ones.

I have spoken of your education in general terms. Should your education be different for different approaches to science—for research, for teaching, for administration? This is a debatable question and I have no time to discuss it at length, even though I have some definite ideas on the subject. A few thoughts must suffice, one of which is that a broad cultural education plus specialization, including research, in the major field of interest, is basic to any approach to science you may wish to undertake. Perhaps this statement would answer the question with respect to your education for research, providing you have certain personal characteristics—imagination, persistence, inquisitiveness, originality.

The first requisite for good teaching is a thorough knowledge of the subject you teach. It matters not how much you know about the theory of teaching if you do not know the subject. Some critics think research is overemphasized by graduate schools in the education of teachers, but I cannot agree, in part because teaching and research, two of the fundamental functions of a university, go hand in hand. Of course some scientists may overemphasize research and neglect teaching, and in such instances research may be said to interfere with good teaching. Other factors, however, may interfere with good teaching, and they are more often found among teachers who do no research. I refer to loss of interest, complacency, intellectual stagnation. Research activity keeps teachers alive.

I shall not discuss the part which theories and methods should play in the education of a teacher. I will say, however, that I think such subjects have been overemphasized in the past. Teaching is an art. While you do not inherit it you may inherit certain characteristics which when developed, aid you in becoming a good teacher. The most important of these characteristics are a love of learning, an interest in young people and in teaching. Even with these characteristics good teaching is to be acquired only by working for it. I suggest among other things that you acquaint yourselves with the best literature on the subject. Learn what you can from good teachers, but don't try to mimic them. Adapt their methods and techniques to yourself, remembering you have an individuality of your own and if you are to be a good teacher that individuality must be preserved. An individuality, however, is not something to be maintained in a state of rigidity, but something to be modified with study and experience. Don't forget, too, that science, through research, is rapidly changing so the course given in 1957 is not the course to be given in 1958.

I cannot tell you how to educate yourselves to become administrators. I wish I could. Books by the hundreds have been written on the subject, but it is one thing to tell someone how to do a job and something else to do it. Good administration as good teaching is not done by rule. Many factors play a part, the most important of which is good judgment. If anyone ever tells you the secret of acquiring good judgment, please pass the information to others. It is much needed.

In closing let me express a few words of caution. If you have made your decision, but while there is still time to change, I ask you to take stock of your own fitness to become scientists. The road is long, arduous and expensive. If you are faint of heart, if you lack determination and will, if your interest is superficial, if you are easily discouraged, if you do not have an inquisitive mind, if you

lack imagination, if you are unwilling to live on a modest income, think twice before you go farther. Only a few acquire riches and only a few acquire fame. Most of us are hewers of wood and drawers of water, important cogs, however, in the advancement of science. On the other hand, if you have the necessary qualifications and are willing to devote yourselves unstintingly to research or to teaching and research, no life is more rewarding.

Making Successful Radioautographs

THEODORE W. MUNCH
Assistant Professor, Science Education, University of Texas

The study of radioisotopes is rapidly becoming a part of many high school science courses. The effect of these isotopes can be studied in a number of ways, most of which require a Geiger-Mueller counter attached to a count-rate meter. For those schools whose budget does not permit the purchase of a G-M counter, the field of radioautography offers interesting and inexpensive opportunities for demonstrations and projects.

Radioautography is the technique which makes use of the influence on a photographic emulsion of the radiations from radioactive bodies. Henri Becquerel first discovered these effects when he noticed that uranium salts could darken a photographic plate. In recent years radioautographic techniques have greatly improved so that now they are highly valuable tools in biological research. This article describes several techniques which can be used to produce successful radioautographs.

Authorization-exempt quantities of radioisotopes may be obtained from many sources. The Abbott Laboratories, Oak Ridge Division, Oak Ridge, Tennessee, will supply 10 microcuries of P-32 and 50 microcuries of S-35 for $5.00, air parcel post-paid. Other companies supplying isotopes are listed at the end of this article. For purposes of this report, Cesium-137 was used. The general technique of developing "autographs" is the same regardless of the isotope used.

The film used should be a fast, fine-grained photographic emulsion. Kodak Royal Pan and Kodak Verichrome Pan were found to be satisfactory in this experiment. The Royal Pan film is packaged in convenient 3¼ x 4¼ inch sheets. The Verichrome Pan comes only in rolls, and the curled paper is a bit tedious to handle. This film, however, is considerably cheaper than the sheet form. Developing of the negatives was done in Kodak DK60A developer for 3¾ minutes, followed by a developer-stopping solution of 28% acetic acid in distilled water for 30 seconds, followed finally by immersion in standard fixer for 8 minutes. Both of the films must be developed in total darkness.

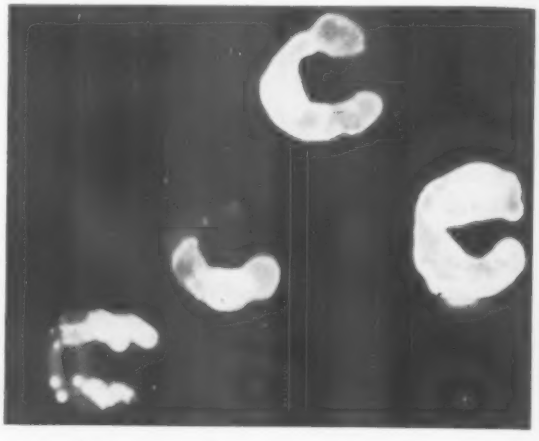

PLATE 1

Developing radioautographs with the use of "coupons." Microscope slide cover slips are used as "coupons." A portion of the radioactive solution is dropped on the cover slip and allowed to dry. Another cover slip is cellophane-taped over the isotope to prevent contamination and smearing. The cover-slip is placed on a piece of film which is exposed for a certain period of time. The exposure time varies with the amount of isotope on the cover-slip. Plate No. 1 shows the results of Cesium-137 on Royal Pan film. Cesium coupon No. 1 is in the lower left hand corner. Coupons 2, 3, and 4 follow on the diagonal to the upper right corner. The following data accompany Plate No. 1.

Coupon No.	*Milliliters of 1 microcurie of Cesium-137*	*Days Exposed*
1	.01	7
2	.15	5
3	.35	4
4	.70	3

If P-32 is used, the same quantities and exposure times apply as when Cesium-137 is used.

Plant radioautographs. Use a fresh piece of celery with as many leaves as possible. Cut about an inch from the bottom of the stem and immerse in 50 ml. of a 5% or 10% solution of uranium nitrate. Add a few drops of red food coloring. Let the celery stand until the red dye shows in the veins of the celery leaves. Place a leaf of the celery on a sheet of film and expose for 5 days. Plate No. 2 shows the results of a celery leaf taken from a stem which had been immersed in a 10% solution of uranium nitrate 48 hours and exposed on Super Pan film for 5 days. If Verichrome Pan film is used, it would be well to expose the film an additional two days.

Translocation in living plants. Obtain young bean, coleus, or corn plants. These may be grown from seed in sand or soil. When the plants are about 8-10 inches high, carefully remove the soil from the roots, wash with tap water, and support the plant between a split cork which has been whittled to prevent crushing the stem. Place the roots in a small narrow-mouth bottle. Add the radioisotope solution in sufficient quantity to cover the roots. Aeration of the roots may be necessary in the case of beans and corn. If 10 microcuries of isotope are used, keep the plant in the solution for at least 7 days. Expose leaves on film for at least 5 days. Kodak film-holders of the type used in a "press" camera have been found to be ideal containers in which to expose the film. Naturally, only relatively flat leaves and stems can be used. Plates Nos. 3, 4, and 5 show radioautographs made by this process.

One precaution needs to be mentioned at this point. To prevent the plant leaves from sticking to the film emulsion, place a thin piece of plastic sheet between the leaf and the film.

If one wishes to experiment with different exposure times and use but one sheet of film, the following process is recommended. Cut two sheets of thin plastic, 3¼ x 4 inches. two sheets of thin plastic, 3 x 4¼ inches.

Tape the narrow ends together. Cut a piece of medium weight lead foil into rectangles 3¼ x 4¼ inches. Notch one side of the foil at four places equidistant apart. Insert the radioactive specimen between the two pieces of plastic. Place the foil beneath the lower piece of plastic. In the lark, tape a piece of film beneath the bottom of the plastic sheets. Pull

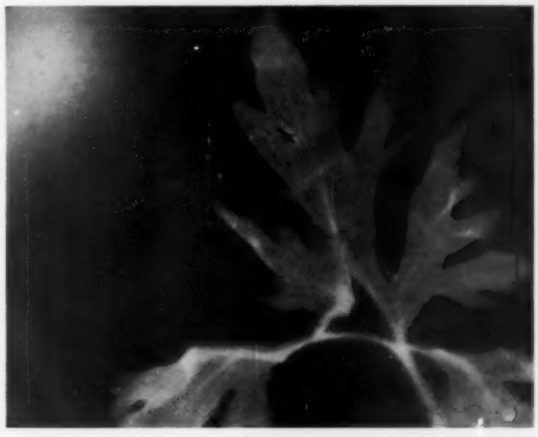

PLATE 2

PLATE 3—BEAN LEAF

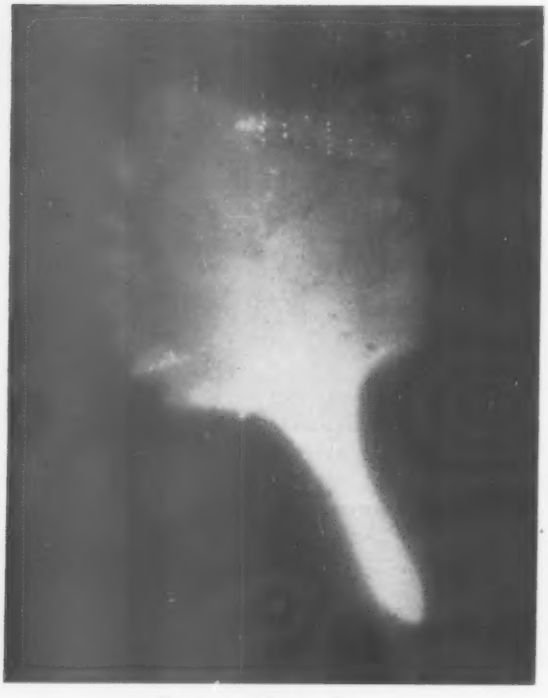

PLATE 4—COLEUS LEAF

PLATE 5—TWO SECTIONS OF CORN LEAF

the lead foil down to the first notch and expose the film for the desired time. Repeat the process until all the specimen has been exposed, using the notches as guide points in the dark room. Fig. No. 1 shows the apparatus described above.

Using radioautographs in science projects. Once the technique of successful radioautography is achieved, many projects may be carried on.

1. Inject I-131 as NaI into young rats. During the next 24 hours collect all the urine and feces. Prepare coupons of excreta. Expose on film. Controls should be run on the urine and feces prior to injection of the isotope.

2. Sacrifice the animals used in No. 1 with an excess of ether. Dissect the thyroid, liver, kidney, and spleen. Prepare thin slices of tissue and wash the slices with cold 0.9% NaCl solution and blot dry. Expose the sections on film in a refrigerator for several days. Compare intensity of darkening caused by various tissues.

3. Compare the absorptive powers of various kinds of plants (corn, beans, tomatoes) with respect to a particular isotope.

4. Determine the time in the life cycle of a plant at which most of a particular element is absorbed into plant tissue.

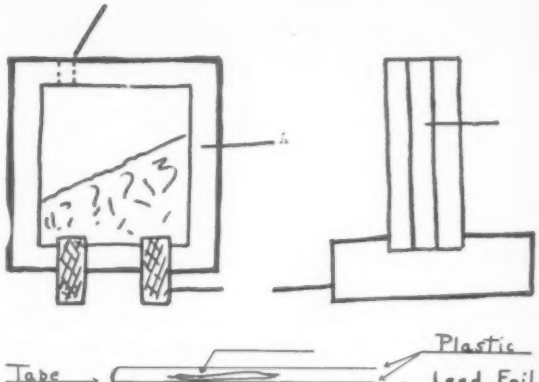

FIG. 1

5. Determine the areas of greatest concentration of an element in the fruit of small plants.

Some Suppliers of Authorization-Exempt Quantities of Radioisotopes

Atomic Research Laboratory
2633 Santa Monica Boulevard
Santa Monica, California

Bio-Rad Laboratories
Radiochemicals Division
800 Delaware Street
Berkeley, California
Isotopes Specialities Company
3816 San Fernando Road
Glendale, California
Nuclear Consultants, Inc.
3361 Crescent Street
Long Island City, New York
Oak Ridge National Laboratory
Radioisotope Sales Department
P. O. Box "P"
Oak Ridge, Tennessee
Oak Ridge Scientific Developments, Inc.
P. O. Box 124
Oak Ridge, Tennessee

Beginning a Herbarium

THOMAS P. BENNETT
Florida State University, Tallahassee, Florida

A herbarium is a collection of dried plants preserved for comparison and study. It consists of plants, with their flowers, roots, leaves and seeds in a displayed state mounted on plain mounting sheets along with information about the plant and its habitat. A herbarium may be made to illustrate a particular botanical problem, to study the flora of a given region and to study variations in plant populations.

The necessary items for a beginner who wishes to increase his knowledge about plants include a trowel, plant press, corrugated board, mounting sheets, collecting sheets, wild-plant handbook, tape, glue.

A plant press can be made from two pieces of ¼ x 17 x 12 inch plywood. Fastening straps can be tied to hold the boards together. Collecting sheets can be made from newspaper which has been folded to be 1½ x 16½ inches.

The preparation of a herbarium can be divided into two parts: the collection of the specimens, and the preservation and proper identification of the specimens.

The herbarium has its beginning in the field where suitable specimens are located and obtained. A specimen is chosen which has all of its leaves, stems, and preferably its flowers or seeds intact. The plant is removed from the ground by digging around the plant at a safe distance so that the roots remain uninjured. It is often necessary to dig relatively deep so that the tap roots of some specimens can be obtained.

Data such as the locality, height of plant, mode of flowering, color of the flowers, etc., should be recorded before or immediately after collecting the specimen.

When the plant has been removed from the ground, it should be placed in a collecting sheet until the time for mounting it.

When ready to press the specimen; i.e., to dry it, the specimen is placed while it is still in the collecting sheet between two pieces of blotter paper. The plant should be arranged as neatly as possible. Each specimen should have each of the parts of the plant represented; at least one flower should be visible, and both sides of the leaf should be displayed. If the root is not too large it should be displayed in its entirety, otherwise a portion of it will suffice. If any part of the plant is too thick for the press it should be split at this time.

The blotters containing the plants should be placed inside the plant press and the straps of the press should be tightened. Weights up to about ten pounds may be placed on the press. The press is then placed in a warm place for twenty-four hours. At the end of this time new blotters should replace the old ones.

Most specimens should not need to have more than three changings of blotters. The total time for drying the specimen should not exceed ten days. When each specimen has been dried it should be properly identified and pertinent data should be recorded.

The specimen is then placed in a centered position on standard mounting paper and is taped to the mounting sheet. The mounted specimen can then be covered with cellophane sheeting for further protection.

A label, which was made when the specimen was identified, should be placed in the lower right-hand corner of the sheet. This label should contain as much information as possible regarding the specimen, its scientific and common name, the collector's name and other data of collection.

"People and Timber," a review of America's timber resources, is now available in single copies from The Forest Service, United States Department of Agriculture, Washington 25, D. C. This booklet is a concise summary of the current timber situation.

Mid-West Institute for High School Biology Teachers

RICHARD R. ARMACOST
Purdue University

First row—Sister M. Margaret Bealmear, O.S.B., St. Joseph High School, Atchison, Kansas; Doris A. Shultz, Southern High School, Louisville, Ky.; Mary G. Phillips, Treadwell High School, Memphis, Tenn.; Frances M. Gourley, LaPorte High School, LaPorte, Ind.; Judith A. Parsons, Upper Arlington High School, Columbus, Ohio; Elsie M. Daubert, Cornwall High School, Cornwall, Penn.; Martha Jacobson (secretary); Richard Armacost (director), Purdue University.

Second row—Pamela R. Patterson, Sullivan High School, Sullivan, Ind.; Benjamin Donaldson, Lodge Grass High School, Lodge Grass, Montana; William A. Taylor, Crispus Attucks High School, Indianapolis, Ind.; Robert J. Connelly, Woodward High School, Cincinnati, Ohio; William R. Stotts, Syracuse High School, Syracuse, Ind.; Mary H. Bond, Anderson Township School, Milroy, Ind.; Patricia Tabor, Valparaiso High School, Valparaiso, Ind.

Third row—William Kastrinos, Glenbard High School, Glen Ellyn, Ill.; Montague M. Oliver, Roosevelt High School, Gary, Ind.; Kenneth H. Bush, West Lafayette High School, W. Lafayette, Ind.; William A. Strow, Culver Military Academy, Culver, Ind.; Raymond Lyon, Southwestern High School, Lafayette, Ind.; Richard L. Fox, Delphi High School, Delphi, Ind.; William B. Crankshaw, Tyner High School, Tyner, Ind.; Maurice Rumsey, Perry Central High School, Perry, New York.

Fourth row—David C. Engleson, Sevastopoe High School, Sturgeon Bay, Wis.; Thomas J. Muncey, Fairfield Township High School, Hamilton, Ohio; Jerry M. Macklin, Portland-Wayne Township, Portland, Ind.; John Allyn, Goshen High School, Goshen, Ind.; Ernest J. Litweiler, Adams High School, South Bend, Ind.

Fifth row—Lynn W. Hinnefeld, Brownstown Cons. School, Brownstown, Ind.; Cary E. Rothenburger, Hanover High School, Hanover, New Hampshire; Gerald M. Hess, Argos Comm. High School, Argos, Ind.; Glen E. Foster, Jamaica Cons. High School, Sidell, Ill.; Dennis C. Blind, Attica High School, Attica, Ind.; William Weishar, Brookfield High School, Milwaukee, Wis.

Sixth row—John Lazar, Jefferson High School, Lafayette, Ind.; Phillip R. Fordyce, Broad Ripple High School, Indianapolis, Ind.; Jack R. Young, Cambridge High School, Cambridge, Ill.; Roger Claseman, Jefferson High School, Lafayette, Ind.; Chris C. Mengel, Central High School, Kalamazoo, Mich.; Kenneth S. Storm, Limestone Comm. High School, Peoria. Ill.; James R. Luff, Zeeland High School, Zeeland, Mich.; Thomas Overmire, Shortridge High School, Indianapolis. Ind.; Blair W. Sullivan, Wendell L. Willkie High School, Elwood, Ind.; Virgil Lee Day, West Jr. High School, Kansas City, Mo.; Manert H. Kennedy, Fraser Public School, Fraser, Michigan.

Seventh row—Paul Webster, Bryan City Schools, Bryan, Ohio; Arthur R. Barnett, Shelbyville High School, Shelbyville, Ind.; Charles E. Smith, Bardstown High School, Bardstown, Kentucky; A. G. Johanningsmeier, Charlotte High School, Charlotte, Mich.; William Houser, T. Roosevelt High School, Des Moines, Iowa; Rev. John Flaherty, O.S.A., St. Rita High School, Chicago, Ill.; James L. Early, South Bend Central High School, South Bend, Indiana.

The Mid-West Institute for High School Biology Teachers was held at Purdue University last summer, June 17 to August 10. The Institute was sponsored by Purdue University and supported by a grant from the National Science Foundation with the National Association of Biology Teachers cooperating.

A number of NABT members came as participants and before August 10th, all 50 teacher-participants were members of the NABT. The adjacent picture shows the "old" and "new" members of the NABT who attended the Institute.

Lecture-discussion sessions were held in the mornings followed by informal laboratory or field work in the afternoons. The basic program and consultants included:

June 17, 18, 19, 20, 21

Topic: Plants and Man

Lecturers: John S. Karling, Head Department of Biological Sciences, Purdue University; Sam N. Postlethwait, Associate Professor of Botany, Purdue University

June 24, 25, 26, 27

Topic: Plant Physiology

Lecturer: Harry J. Fuller, Professor of Botany, University of Illinois

July 1, 2, 3, 5

Topic: Animal Systematics and Ecology

Lecturers: Fred Cagle, Head Department of Zoology, Tulane University; Clarence J. Goodnight, Professor of Zoology, Purdue University

July 8, 9, 10, 11

Topic: Animal Physiology and Endocrinology

Lecturers: Jacob E. Wiebers, Research Associate in Biological Sciences, Purdue University; M. X. Zarrow, Professor of Endocrinology, Purdue University

July 12, 16, 17, 18, 19

Topic: Bacteriology and Mycology

Lecturers: Stanley E. Hartsell, Professor of Bacteriology, Purdue University; Merwin Moskowitz, Associate Professor of Bacteriology, Purdue University; Henry Koffler, Professor of Bacteriology, Purdue University; Charles Porter, Professor of Mycology, Purdue University

July 22, 23, 24, 25

Topic: Plant Systematics and Ecology

Lecturers: C. B. Heiser, Jr., Professor of Botany, Indiana University; A. A. Lindsey, Associate Professor of Plant Sciences, Purdue University

July 29, 30, 31

Topic: Parasitology

Lecturer: Raymond Cable, Professor of Parasitology, Purdue University

August 5, 6, 7, 8

Topic: Genetics

Lecturer: Herbert Riley, Head Department of Botany, University of Kentucky

Many other scientists contributed to the program, and a number of additional sessions were arranged by the participants. Tours of the facilities and research programs at Purdue University were taken. All participants also worked on an individual study problem concerned with their school biology program. Some of the progress reports of these will be published in future issues of *The American Biology Teacher.*

The Use of a Botanical Classification In a High School Biology Class

JAMES A. McCLEARY
Professor of Botany
Arizona State College at Tempe

For a number of years, it has been the practice of the majority of high school biology teachers with whom I have had personal contact, to eliminate the teaching of the classification of the plant kingdom for a number of very tenuous reasons such as: too difficult; too time-consuming; valueless, etc. At the same time, these same teachers do not hesitate to teach the classification of the animal kingdom in its entirety. To a person who has had 7 years of high school and 10 years of college biology and botany teaching, these reasons seem very inadequate and the practice very illogical. It is the purpose of this article to encourage the return to the practice of including the plant kingdom by giving a brief outline of the history of plant systematics and a little of the modern thinking on the subject.

Perhaps the chief reason why botany in all its phases is regarded so lightly is the lack of preparation on the part of the teacher. Many college biology departments are staffed primarily by zoologists for the purpose of offering a pre-medical training which usually includes, at most, one semester of botany in the freshman year. When difficulties arise and medical school seems out of the question, the student often turns to the field of education as an alternative. This in itself is not necessarily an undesirable state of affairs but it does make for an extremely lop-sided biological training for high school teachers. Moreover, during the time until that student is on the other side of the desk as a teacher, he is not exposed to botanical terms nor names, and as a consequence, unless he is extremely conscientious and energetic and can overcome his inertia, the use of a technical classification for other than the flowering plants is more than he cares to undertake. An expression which the writer often applies to many agriculture students, seems to fit the thinking of numerous biology teachers as well: "If a cow can't eat it, what good is it?" This avenue of thinking promptly excludes all mention of classification other than that of the seed plants.

Despite this experience, recent articles seem to indicate the need of proper classification even at the high school level. Mallinson and Buck (5) describe a method of introducing the four phyla to their students while Mallinson (4) says: "Teachers at high school and college levels need to ask: is the purpose of our teaching to enable the student to assemble a mass of botanical facts to be disgorged at test time, or is it to enable them to search for and recognize botanical truths, to recognize botanical relationships, and to make use of botanical facts?" The report of the Southeastern Conference on Biology Teaching held in 1954 at the University of Florida also indicates a need of an understanding of this type of training and suggests that (Cagle, 1): "The greatest value is the use of the system of classification as a frame of reference . . . an understanding of the uses of the system will permit vast extensions of knowledge." If, as Cagle states, classification permits vast extensions of knowledge, good pedagogy would demand that all categories of classification be included, not just that in which man happens to find himself.

The use of four phyla or divisions of the plant kingdom, the Thallophyta, Bryophyta, Pteridophyta, and Spermatophyta began in 1886 when August Wilhelm Eichler (3) divided the plant kingdom into two subkingdoms, Cryptogamae and the Phanerogamae with the Thallophyta, Bryophyta and Pteridophyta under the Cryptogamae and the Angiospermae and Gymnospermae (latter combined into the Spermatophyta) under the

Phanerogamae. The Thallophyta, in turn, was later separated into algae and fungi with the algae including the classes Cyanophyceae, Chlorophyceae, Phaeophyceae and Rhodophyceae. On the basis of Saccardo's (8) Sylloge Fungorum, the fungi has been divided into the following classes: Schizomycete, Myxomycete, Phycomycete, Ascomycete, Basidiomycete and the form-class Deuteromycete or Fungi Imperfecti. The Bryophytes included the Hepaticae and Musci while the Pteridophyta encompasses the classes Equisetineae, Lycopodineae and Filicineae. In its entirety, the system appears as follows:

Cryptogamae	
Thallophyta	
Algae	
Cyanophyceae	Blue-green algae
Chlorophyceae	Green algae
Phaeophyceae	Brown algae
Rhodophyceae	Red algae
Fungi	
Schizomycete	Bacteria
Myxomycete	Slime molds
Phycomycete	Algae-like fungi
Ascomycete	Sac fungi
Basidiomycete	Club fungi
Deuteromycete	Imperfect fungi
Bryophyta	
Hepaticae	Liverworts
Musci	Mosses
Pteridophyta	
Equisetineae	Horsetails
Lycopodineae	Club mosses
Filicineae	Ferns
Phanerogamae	
Spermatophyta	
Angiospermae	Flowering plants
Gymnospermae	Cone bearing plants

This is essentially the system which is now used in most high school and college biology texts and even some general botany books. However, the majority of the more recent of the botany texts have changed to a more modern classification, taking their cue from Tippo (10) who in turn follows Smith's (9) outline for non-vascular plants and Eames (2) arrangement for the vascular plants. Smith raised the question: "Is this (the Thallophyta) a natural division of the plant kingdom that may, in turn, be divided into algae and fungi? To accept the Thallophyta as a natural division of the plant kingdom implies acceptance of the view that all algae are more or less closely related to each other." He refutes this and advances the theory that the algae must be classified on the basis of the morphology and physiology of the individual cells. The structure of the motile cell with respect to the number, arrangement and length of its flagella and the constance of the pigments in the plastids plus the chemical nature of the accumulating food reserves are the factors useful in this instance. This means that while the algae along with the protozoa may have had a common ancestry, separation occurred so long ago in the past that those taxa are now sufficiently distinct to warrant placing each in a separate division of the plant kingdom. Following this thinking, the algae are thus alined in the following with all endings using the greek 'phyta': Chlorophyta, Euglenophyta, Chrysophyta, Phaeophyta, Pyrrophyta, Cyanophyta and Rhodophyta. The Chrysophyta is composed of plants separated from the Chlorophyceae and the Phaeophyceae while the Pyrrophyta is derived from species which were not well known to early algologists and usually not encountered even in general courses at the college level.

The same problems which faced the phycologist also faced the mycologist. Were the classes of fungi of equal rank? Did the separation of fungi into classes really indicate their true relationship? Agreement was soon reached that all true fungi (other than the bacteria) should be placed together but that the "slime molds," of uncertain origin, should be removed from the other fungi and occupy equal rank with it. Hence, the fungi are divided into two divisions, the Myxothallophyta and the Eumycetae (later on this became the Eumycophyta). To the latter belong the Phycomycetae, Ascomycetae, Basidiomycetae and the Fungi Imperfecti.

The Bryophyta continues to remain a distinct entity. However, the Pteridophytes and Spermatophytes were brought together by Eames into the Tracheophyta or those plants having similar vascular structure. This division, in turn, was divided into several subphyla or sub-divisions such as the Psilopsida (entirely fossil), the Lycopsoda and the Pteropsida. More recently, other authors have elevated these subdivisions to divisions with "phyta" again as the correct ending. In 1946, Papenfuss (6), suggested that the spelling of

the algal divisions incorporate the Greek "phycos" (algae) in the framework of the word and also that the fungi contain the word "mycos" (fungus) thus changing the spelling to such as Chlorophycophyta (green algae plant) and Eumycophyta (true fungus plant).

Another change that has occurred is to place the "blue-green" algae and the bacteria together on the basis that neither contains a true nucleus nor distinct plastids. General concurrence has not been reached at this point since some investigators using the electron microscope have claimed to have seen a nucleus in bacteria. For this combination, the Schizophyta is used. More information concerning the "stone-worts," formerly placed in the green algae, have caused this group of plants to be placed in a separate division, the Charophycophyta. Thus, the entire classification appears in Robbins and Weier (7).

Schizophyta	Bacteria and blue-green algae
Chlorophycophyta	Green algae
Charophycophyta	Stoneworts
Euglenophycophyta	Euglenoids
Phaeophycophyta	Brown algae
Rhodophycophyta	Red Algae
Myxomycophyta	Slime molds
Eumycophyta	True Fungi
Bryophyta	Mosses and liverworts
Sphenophyta	Horsetails
Lycophyta	Club mosses
Pterophyta	Ferns and seed bearing plants.

Comparison of the old and new systems shows a similarity which can be understood by anyone with a slight knowledge of either. Actually, the system followed is not nearly as important as that some system should be used. If, as Mallinson indicates, the purpose of teaching botany is to enable the student to recognize relationships, the use of either of these should fulfill the purpose. As long as some scheme must be used, why not teach that which seems to be more nearly correct. Upon first glance, it seems unfortunate that all botanists do not hold the same opinions concerning each aspect of plant taxonomy and phyllogeny. This may, however, be taken as an increase or revival of interest in botany. Differences of opinions mean that the goal of truth is being approached. A stable classification would indicate one of two things: either, the goal has actually been reached or botanists have become too set in their opinions. Personally, the author prefers advancement rather than stagnation.

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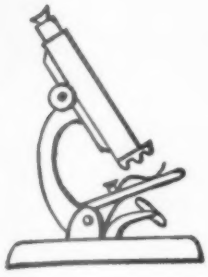
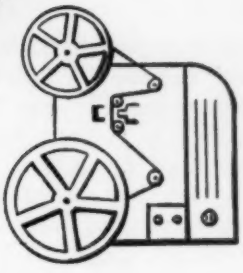
Air Pollution

Dr. Morris B. Jacobs, director of laboratory in New York's Department of Air Pollution Control, warned that "nitrogen oxides are poisonous gases that are particularly dangerous because of the insidious character" of their action on the body. Unlike many toxic gases, they have no objectionable odor and do not irritate the nose and throat, even in a dangerous concentration, he explained. Excessive quantities of nitrogen oxides can attack the lungs and cause a condition like pneumonia. It was calculated back in 1953 that the amount of nitrogen oxides as nitrogen dioxide, arising from the burning of fuel oil, fuel gas, gasoline, and refuse from general public emissions, from petroleum industry emissions, and from other industry emissions in the City of Los Angeles totalled as much as 284 tons per day in 1950. It is highly likely that this amount has increased. Undoubtedly amounts of nitrogen dioxide of this order are emitted to the New York City atmosphere.



A-V NEWS



EMERY L. WILL, Head Science Department
State University Teachers College, Oneonta, N. Y.

Once again, at the December meeting of the NABT, the Audio-Visual Committee will present two showings of new classroom films in the biological sciences. This year's film preview sessions have been arranged with the valued help of Doris L. Lynn, who heads the Audio-Visual Department of the Indianapolis Public Schools. The hour-long sessions will begin at 7:50 A.M. on Friday and Saturday, December 27-28. Among the excellent new films scheduled for showing are: Indiana University's *Basic Nature of Sexual Reproduction*, Pat Dowling's *The Ladybird Story*, Encyclopedia Brittanica's *Protozoa*, and the New York Zoological Society's *Adelie Penguins of the Antarctic*. We hope to see you there.

Have you wondered where you should write for the loan of U. S. Department of Agriculture films? You can obtain a list of these film libraries from the Motion Picture Service, U. S. Department of Agriculture, Washington 25, D. C. Generally, most of the film libraries listed are at the land-grant colleges in the various States.

Increasing numbers of elementary and high school teachers of biology are making use of projection equipment to augment laboratory microscope work. Both the microprojector and the overhead projector help the teacher to focus students' attention on difficult-to-see structures.

For years, photographers have devised means for using prism binoculars as a telephoto lens, with varying degrees of success. The Bino-Tach attachment fits every make and size of prism binocular, photo panhead and tripod. Holding the glasses firmly, it permits their use with a camera. It also enables infirm persons to guide binoculars with the least effort, and with great steadiness. Harry Ross, 70 West Broadway, New York 7, N. Y.

Bell & Howell's newest Filmosound 16 mm. magnetic-recording projector features a 50 per cent increase in power and distortion-free sound. The 15-watt amplifier permits effective use in large auditoriums. The user can even record his own soundtrack on film, no matter if the film is single- or double-perforated. Bell & Howell Company, 7100 McCormick Road, Chicago 45, Ill.

If you expect to be in Washington, D. C., during the period January 27-31, why not arrange to visit the sixth annual USDA Visual Workshop, sponsored by the Motion Picture Service of the Department of Agriculture. This year, the general theme will be "Creativity." By the way, the USDA's film production schedule currently includes several titles which should be of considerable value to teachers; subjects include: the Japanese beetle, activities at the Forest Products Laboratory, forest genetics, cotton research, and agricultural pests.

Fast and convenient determination of exposure time in photomicrography is made possible with the aid of specially-designed exposure meters announced recently. The Ipscaphot meter is designed for measuring normal intensities, while the Microphot can be used for all light intensities, including extremely low ones. This company also is the source for low power micromanipulators. C. A. Brinkmann & Company, 378 Great Neck Road, Great Neck, L. I., N. Y.

A new, low-priced table stand for horizontal and vertical positioning of AO Series 55 Cycloptic Stereoscopic Microscopes has been announced. The stand permits a four foot circular swing around a vertical pillar, and

allows a 20 inch horizontal and a 15 inch vertical excursion. American Optical Company, Instrument Division, Buffalo 15, N. Y.

Bell & Howell, who earlier this year announced a new line of spool-loading 16 mm. motion picture cameras, inform us of the availability of four new publications on the effective use of A-V materials. For a dime each, you can obtain booklets on teaching and training with filmstrips, tape recorders, magnetic sound motion pictures, and optical sound motion pictures. Educational Sales Department, Bell & Howard, 7100 McCormick Road, Chicago 45, Ill.

The McGraw-Hill Book Company, whose Text-Films have gained favor with high school and college science instructors, now has acquired for distribution the elementary-junior high films and filmstrips made by Young America Films. However, for the immediate future, correspondence regarding YA materials should be directed to the YA office at 18 East 41st St., New York 17, N. Y.

A special bouquet is in order for the educational television series, "Discovery," presented from WGBH Boston by the Lowell Institute Cooperative Broadcasting Council, in cooperation with the Children's Museum of Boston and the Massachusetts Audubon Society. NABT member Charles Walcott has figured prominently in the production and photography. The series has been notable for its interesting and challenging presentations of significant topics in the natural sciences. During 1956-57, this was a highly popular Friday evening program.

SOME RECENT FILM AND FILMSTRIP RELEASES

FOSSILS ARE INTERESTING. 11 min., sd., color. The earth's changing surface reveals evidence that life, too, is changing; a fossil-hunting field trip uncovers evidences of plant and animal forms that lived long ago. Upper elem., jr. high. Film Associates of California, 10521 Santa Monica Blvd., Los Angeles 25, Calif.

THE AGRICULTURE STORY. 14 min., sd., color. Through dramatization of the forces of nature, scientific progress, and accomplishments of American farmers, the film reveals why American agriculture is the most efficient and productive in world history; includes services of the USDA and other organizations. High school-adult. Loan from most Land-Grant College film libraries. U. S. Dept. of Agriculture.

FROM THE GROUND UP. 14 min., sd., color. The importance of soil to world food supply is pointed out in this story of the work of the soil surveyor; tools of his trade are shown in action; development of conservation plans and watershed management plans as a follow-up to the soil surveyor's work. High school-adult. Loan from most Land-Grant College film libraries. U. S. Department of Agriculture.

PREHISTORIC ANIMALS OF THE TAR PITS. 14 min., sd., color. The famed tar pits at Rancho La Brea in Los Angeles; the work of museum scientists in re-creating the past; use of models to show tar pit episodes. Upper elem.-jr. high. Film Associates of California.

ZOO ANIMALS–MAMMALS–PART I and *ZOO ANIMALS–MAMMALS–PART II.* Each film 11 min., sd., color. Behind the scenes at the San Diego Zoo, first with the kinkajou, lesser panda, Indian elephants, lions, tigers, and sea lions. Emphasis is placed on creating satisfactory living conditions for these animals, as well as simulating their natural surroundings. The second film includes the Axis deer, eland, zebra, kangaroo, koala, bears, and a chimpanzee. Again, care and feeding of the animals is illustrated. Elem.-jr. high. Academy Films, 800 North Seward St., Hollywood 38, Calif.

OCEAN TIDES: BAY OF FUNDY. 14 min., sd., color. The 50-foot tidal range at the bay of Funday affords an excellent opportunity for observing the many effects on various forms of life as the tides ebb and flow. Upper elem.-sr. high. Encyclopedia Brittanica Films, 1150 Wilmette Ave., Wilmette, Ill.

SEED DISPERSAL (2nd edition). 11 min., sd., color. The dispersal and germination of seeds, through the action of wind, water, man, wildlife, and other means. Upper grades-sr. high. Encyclopedia Brittanica Films.

HOW WATER HELPS US. 11 min., sd., color. Importance of water in everyday living, as source of food, for transportation, and for other purposes. Primary. Coronet Instructional Films, Coronet Bldg., Chicago 1, Ill.

WE EXPLORE THE WOODLAND. 11 min., sd., color. Grandpa takes the children out to visit the woods, where they find the woodland to be a home shared by many different plants and animals. Primary. Coronet.

FOSSILS: CLUES TO PREHISTORIC TIMES. 11 min., sd., color. Formation, location and significance of fossils; use of specimens, dioramas, animation. Upper elem. Coronet.

HOW BIRDS HELP US. 11 min., sd., color. Values of birds as food, insect destroyers, weed seed consumers, and desirable members of the natural community. Primary. Coronet.

HOW INSECTS HELP US. 11 min., sd., color. The many useful insects around us, and how they are beneficial. Primary. Coronet.

CREATURES OF THE DESERT. 11 min., sd., b&w. The variety of animals inhabiting desert areas of the American Southwest; the adaptations which enable these forms to survive in the hot, dry climate. Upper elem.-sr. high. Young America Films, Inc., 18 East 41st St., New York 17, N. Y.

FOREST TENT CATERPILLAR. 18 min., sd., color. Life history and economic importance of this insect; closeup photography of all stages of development. Sr. high and up. National Film Board of Canada, 630 Fifth Ave., New York 20, N. Y.

MAN AGAINST A FUNGUS. 37 min., sd., color. The wheat rust and its effects upon agriculture; detailed studies of life history, with its complex alternation of generations. Sr. high and up. National Film Board of Canada.

Books for Biologists

PERSPECTIVES IN BIOLOGY AND MEDICINE, a new quarterly juornal dedicated to a multidisciplined approach to the problems of biology and medicine, is announced by the Division of Biological Sciences and the Press of the University of Chicago.

PERSPECTIVES will present new hypotheses and concepts representing informed thinking; interpretive, selective essays which take stock of the implication of recent and current research and indicate strategy for the future; and, because perspective and inspiration can also be gained by looking to the past, reviews by great men in science and medicine of their formative years and their philosophy of research.

THE PRINCIPLES OF HEREDITY, Fifth edition, Laurence H. Snyder, has been helped by Paul R. David in this new edition, 519 pp., $6.25, D. C. Heath and Company, Boston 16, Mass., 1957.

This book is comprehensive and thorough– rich in illustrative material reflected from both plant and animal genetics. There is a new chapter on genetics of bacteria and viruses, two chapters on giant chromosomes– both dealing with chromosomal aberrations; a discussion of pseudoallelism, and a discussion of the structure and genetic importance of desoxyribose nucleic acid. The rewriting and rearrangement has given a simple, direct style aimed at the beginning student.

THE WORLD OF THE DINOSAURS, David H. Dunkle, 22 pp., , Smithsonian Institution, Washington, D. C., 1957.

Interested adults will find this booklet an invaluable source on this fascinating subject. Illustrations, charts, and text tell the highlights of dinosaur life, and photographs picture many of the fossil skeletons that are exhibited in the Smithsonian Natural History Building in Washington.

THE DESCENT OF PIERRE SAINT-MARTIN, Norbert Casteret, 160 pp., $4.75, The Philosophical Library, Inc., New York, New York.

The principal part of this book is an astonishing account of the gradual exploration and final conquest of the vast cavern of Pierre Saint-Martin in the Pyrenees.

MAN, HIS LIFE, HIS EDUCATION, HIS HAPPINESS, A. daSilva Mello, 729 pp., $6.00, Philosophical Library, New York, New York, 1956.

This book deals in a free and lucid style with man, more precisely modern man in a broad criticism of his life, beliefs and the by-laws of his society.

UNESCO SOURCE BOOK FOR SCIENCE TEACHING, Unesco, 220 pp., $3.00, Unesco, Drukkery, Holland, N. Y., Amsterdam, 1956.

This book gives detailed instructions for teaching and student laboratory experiments in general science, plant and animal study, minerals and fossils, air pressure, water and weather, me-

Books for Biologists

(continued)

chanics, sound, heat, magnetism, electricity and light and the human body. Useful notes to teachers and suggestions for obtaining the materials are included.

HEALTH IN THE ELEMENTARY SCHOOL. Walker, Herbert. The Ronald Press Company, New York 10, N. Y. 228 pp. 1955. $4.00.

This book covers the best practices in health education and health welfare in the elementary school. The conservation of vision and hearing, the control of communicable diseases, emergency care, a program for physically handicapped children, safety and physical education are just a few of the significant topics. This book should prove helpful to the school administrator, to the elementary school teacher as well as to those college students preparing for a teaching career.

AN INTRODUCTION TO THE STUDY OF INSECTS, Donald J. Borror and Dwight M. Delong, 1030 pp. $9.50, Rinehart and Co., Inc., New York, New York, 1955.

The importance of the role played by insects in the world of living things is becoming more appreciated every year, not only because of attention given to the species which act as pests, but because of the increasing realization that many species are extremely valuable to man. This book emphasizes both insect and identification. A text for beginning college entomology, it is a guide for teachers and others interested in the study of insects, and is designed to include laboratory and field work.

SCIENCE TEACHING IN SECONDARY SCHOOLS, John S. Richardson, 385 pp., $6.50, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1957.

This book is directed to those responsible for science in the school curriculum, that they may be concerned with the social and economic implications of science and technology, and that they might stimulate and nurture the creative intellect. Emphasis is placed upon methods and procedures, evaluation, planning, materials and resources.

HEALTH AND FITNESS, Third edition, Florence Meredith, Leslie W. Irwin, Wesley M. Staton, $4.50 pp., $4.20, D. C. Heath and Co., Boston, Mass., 1957.

This health and hygiene textbook applies health principles to the students' everyday life, furnishes basic information about the structure and functioning of the body, and broadens his understanding of the medical sciences. Up-to-date facts and statistics on health and safety presented through colorful cartoons and graphs. The teacher's manual contains answers to questions, references to books, a film list, and material on sex education.

THE COMPLETE BOOK OF GREENHOUSE GARDENING, Henry T. Northen and Rebecca Northen, 353 pp., $6.50, The Ronald Press Co., New York, New York, 1956.

In understandable language and step-by-step illustrations, this comprehensive book tells the gardener things he needs to know about growing plants under glass. Specific information on growing a wide variety of plants suitable for a greenhouse occupies the largest portion of the book. Detailed instructions are given on modern methods of plant propagation, crossbreeding, and the control of shape, stature, and flowering.

PLANT CLASSIFICATION, Lyman Benson, 688 pp., $9.00, D. C. Heath and Company, Boston, Mass., 1957.

An elementary text designed for a college course without prerequisite, to open up a new world of living plants to college students and the educated public. It deals with the higher taxonomy—divisions, classes, subclasses, orders and families. The numerous plant dissections and illustrations are excellent. The study is based upon developing a working vocabulary, the process of identification, understanding the preparation and preservation of specimens and the basis for classification, and appreciation of the association of species.

RISK AND GAMBLING, John Cohen and Mark Hansel, 153 pp., $3.50, Philosophical Library, Inc., New York, New York.

This book is a first attempt to define a new area of scientific inquiry—the study of subjective probability. Teachers and students of psychology and education will be particularly interested in stages of intellectual development revealed by the various experiments and also in their bearing on beliefs in luck, magic and chance.

INTRODUCTION TO BIOLOGICAL SCIENCE, Clarence W. Young, G. F. Stebbins, and F. G. Brooks, 555 pp., $4.75, Harper and Brothers, New York 16, N. Y., 1956.

In the first part of this book attention is centered upon the life processes as displayed in the species *Homo sapiens*, and in the second part upon the relationship between the life of mankind and of the whole organic world. The rather complete glossories and the summary outlines at the end of each chapter helps one conquer the bewildering mass of detail required for an adequate approach to biological sciences.